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An examination of the topographical maps of that region, published by the U. S. Geological Survey, shows that about ten miles this side of Mt. Whitney there is a group of peaks known as Milestone Mountain, the highest of which is given as 13,682 feet. I find, however, that the line of sight to Mt. Whitney passes just south of the Milestone peaks.

As further tending to identify Mt. Whitney, there is a sharp, isolated peak just to the north, in the proper direction for a peak on the map named Mt. Russell, whose altitude is 14,190 feet.

The close agreement of the directions, together with the appearance and facts above noted, convince me that it is Mt. Whitney which we see. C. D. PERRINE.

MT. HAMILTON, CAL., January 18, 1909.

NOTE ON THE SPECTRUM OF COMET *c* 1908 (MOREHOUSE).

In *Lick Observatory Bulletins* Nos. 145 and 147 the writers have published the results of the spectroscopic observations, both visual and photographic, of Comet *c* 1908. In the early visual observations Mr. CAMPBELL noticed that the spectrum had unusual features. The carbon bands at λ 4737, λ 5165, and λ 5635 were present in their usual relative intensities, but three bands to the violet of λ 4737, and a feeble one near $H\beta$ seemed to be new, or at least in very much greater relative strength than in previous comets observed at Mt. Hamilton. Four spectrograms of the comet were secured. The new lines (or bands) were recorded strongly, with the exception of the one near $H\beta$, for which region the plates used are not very sensitive.

The continuous spectrum seems to be almost entirely absent —all but a few per cent. of the photographic light being concentrated in seven lines at λ 3913, λ 4003, λ 4023, λ 4255, λ 4276, λ 4549, and λ 4571, in two lines at λ 4690 and λ 4715 which are probably the edges of flutings in the fourth carbon band, and in two lines at λ 3869 and λ 3883 which are due to cyanogen. We are unable to suggest a probable origin for the first seven lines mentioned. The six lines between λ 4003 and λ 4571, both inclusive, are no doubt identical with three pairs of lines observed by CHRÉTIEN[1] in the spectrum of

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[1] *Comptes Rendus,* **145,** 549, 1907.

Comet *d* 1907, and three bands observed by Deslandres[1] and Evershed,[2] all using objective-prism spectrographs. Radiations having these wave-lengths seem to be relatively strong in the tails of comets, as it is difficult otherwise to account for their essential absence from the spectra of the heads of Comet *d* 1907 and other comets, as observed with slit-spectrographs.

The most striking feature of the spectrograms is the nearly complete concentration of the light in pairs of lines (or bands) with intervals between the pairs approximately proportional to the wave-lengths of the lines;—that is, $\frac{\Delta\lambda}{\lambda}$ is constant, within the unavoidable errors of observation. The existence of these pairs of lines, with the lines in the pairs separated by about the same intervals, is strongly suggestive of closely related origins. The most promising hypothesis as to their origin seems to us to be that they are related to each other in much the same way as the well-known carbon bands or cyanogen bands are related. We are inclined toward the opinion that the six lines referred to may be the edges of flutings in three bands of some element or compound not yet observed in the laboratory.

In an important paper on the comet spectrum, M. Deslandres[3] expresses the opinion that the doubling of the lines is "probably a Doppler effect." As the relation, $\frac{\Delta\lambda}{\lambda} =$ constant, always holds for displacements of the lines throughout a spectrum by virtue of the motion of the light source in the line of sight,—the Doppler-Fizeau effect,—we had considered this explanation, but discarded it as improbable. It may be of value to state briefly the reasons which led us to look for a different explanation.

The pairs of bright lines or bands forming the basis of this discussion are: λ 4003-23, λ 4255-76, and λ 4549-71. Possibly the lines at λ 4690 and λ 4715 may also be included, but we feel confident that they are parts of the blue carbon band usually observed in comet spectra. The interval between the pairs, as observed by Deslandres on October 14th and November 1st, and by us on November 28th, remained constant within the errors of observation, and amounted to about twenty-one tenth-meters in the $H\gamma$ region. As a Doppler-Fizeau effect, this corresponds to a relative motion of 1450^{km} per second in the line of sight.

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[1] *Comptes Rendus,* **145,** 445, 1907.

[2] *Monthly Notices R. A. S.,* **68,** 16, 1907.

[3] *Comptes Rendus,* **147,** 951, 1908.

Assuming the inner section of the tail to lie, as usual, in the prolongation of the radius vector, the observed speed of 1450^{km} would be the projected equivalent of speeds of 2040, 2240, and 1840^{km} per second along the tail, or of 2040, 1920, and 2380^{km} per second transverse to the tail, respectively, on the three dates quoted.

The spectrograms show that by far the greater part of the photographic light of the comet's head and inner tail,—and perhaps of the entire tail,—falls in the six lines in question; which major part is divided about equally between the more refrangible and the less refrangible components.

The integrated image recorded by the ordinary camera should give results as to velocity not out of harmony with those indicated by the six lines into which the tail is chiefly resolved by the prism. These integrated images show by means of condensations within the tail that the speeds along the tail are of moderate and ordinary dimensions, not exceeding 30 or 40^{km} per second within say a million kilometers of the nucleus. Judging by the great brilliancy of many of the condensations, by the sharp bends, in which all the radiating material seems to fall, and by the fact that nearly all the brilliant part of the tail possesses a common general curvature, it does not seem that there can be much light radiated by matter moving fifty or sixty times as rapidly. Small and very narrow streamers are sometimes developed to considerable lengths between two successive dates, indicating probable speeds up to 200^{km} per second, but these emit only a small percentage of the total light of the tail, and therefore cannot have exerted an appreciable influence upon the observed spectrum.

The theory of a relative motion transverse to the axis of the tail, equal to $1900\text{-}2400^{km}$ per second, seems to meet with difficulties equally great. We should not expect rays of any known kind representing one component, or both components, of the three pairs of lines,—i. e., three eighths and perhaps three quarters of all the photographic radiations,—to move transversely to the tail, either along straight lines into distant space, or by rotation, without the ordinary integrated images showing the effects. The photographs of the present comet suggest rotational effects,[1] but on too small a scale.

If a transverse motion were radial with reference to the nucleus and to the axis of the tail it would seem that a slit of the width employed should have a broad band for its image instead of two widely separated lines or bands, at least in the vicinity of the nucleus. If the motion were rotational, either a wide or a narrow slit should give a single line or band,—unless the tail were hollow and the slit took in both of its brightened borders. The integrated images show no such bright-bordered tails.

We judge that the prismatic-objective spectrograms obtained by PLUVINEL and by DESLANDRES show the two component images of a pair to be similar and parallel, at least out to a considerable distance in the tail. It seems improbable that any conditions, electrical or otherwise, would favor uniform speeds, —either radial or rotational,—throughout a long section of the tail.

Perhaps the strongest evidence against the Doppler-Fizeau explanation of the pairs lies in the apparent constancy of the intervals. These were observed to be the same on the three days, October 14th, November 1st, and November 28th; whereas, from the changed angle at the comet between its radius vector and our line of sight, we should have expected the intervals in the pairs to vary four or five tenth-meters from November 1st to November 28th, whether the assumed cause of the doubling be motion along or transverse to the tail. Such a variation did not occur. It should be noted that CHRÉTIEN's observations of Comet *b* 1907, August 16th-18th, gave an average interval of twenty-two tenth-meters for the three pairs of lines, with the angle at the comet equal to 77°. The corresponding speeds would be 1550^{km} per second along the tail and 6900^{km} transverse to the tail. The intervals obtained by CHRÉTIEN for the three pairs of lines were respectively eight, seventeen, and thirty-nine tenth-meters. Whether the wide range in the values is real or accidental, due to the faintness of the lines in that comet, we cannot judge.

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[1] Especially noteworthy in this connection are the observations by BALDET and QUENISSET, in *Comptes Rendus*, **147**, 1033, 1908.

The possible existence of an $H\beta$ radiation, as reported by Mr. Campbell for October 20th, may prove of interest in connection with the suggested canal-ray Doppler-Fizeau effect.

As stated in our former paper on the spectrum, we incline to the view that the lines are observed nearly in their normal positions, and that the double lines are possibly the edges of flutings in bands not yet observed and identified in the laboratory. In this connection we should not overlook the faint lines at λ 453- and λ 423-, which may be the edges of other and fainter flutings in the same bands. Attention should be called to the strong line at λ 3913, which is not doubled. It seems to stand alone in this regard.

If we take either the more refrangible or the less refrangible component of each of the four pairs of lines between λ 4002 and λ 4715 and form the successive differences in the wavelengths, we find that the second differences are constant within the errors of observation. This may indicate, as the source of these radiations, a substance or compound closely related to carbon.

Inasmuch as an identity has been shown to exist between certain comets and meteor streams, and laboratory analyses have shown meteorites to differ widely in chemical composition, it would not seem surprising that there should be different types of comet spectra.

It is hoped that Pluvinel and Deslandres have been able to obtain observations additional to those already published which shall test thoroughly the various explanations suggested. Dr. Curtis, in charge of the D. O. Mills Observatory at Santiago, Chile, has been asked to secure an extensive series of spectrograms with a one-prism slit spectrograph and with an improvised objective-prism spectrograph during the several months that the comet will be favorably situated for observers in the southern hemisphere.

W. W. Campbell,
Sebastian Albrecht.

January, 1909.

The Brightness of the Corona of January 3, 1908.

The attempt by the writer to determine the total brightness (photographic) of the corona of August 30, 1905, was not successful, owing to the thin clouds. Two negatives, together